

1. A liquid crystal display device, comprising:
two substrates facing and spaced from each other, at least one of the substrates being transparent;

5 electrodes positioned to establish an electric field in the space between the two substrates;
one or more space elements located between the substrates;
one or more polymer supports located primarily in the vicinities of the spacer elements, the polymer supports extending between the two substrates and having been polymerized in situ in response to PIE material carried on or within the spacer elements; and
10 electrooptic material filling at least a portion of the space between the two substrates.

2. The liquid crystal display device of claim 1 wherein the spacer elements comprise a large number of generally spherical or cylindrical elements.

15 3. The liquid crystal display device of claim 2 wherein the spacer elements comprise glass.

4. The liquid crystal display device of claim 3 wherein the glass is etched and the PIE material adheres to the etched glass surface.

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5. The liquid crystal display device of claim 2 wherein the spacer elements comprise plastic.

6. The liquid crystal display device of claim 5 wherein the plastic is porous and the
25 PIE material is absorbed into the porous structure.

7. The liquid crystal display device of claim 2 wherein the spacer elements comprise high-surface area particles that are nanoporous, mesoporous, or microporous.

30 8. The liquid crystal display device of claim 2 wherein the spacer elements are randomly located in the space between the substrates.

9. The liquid crystal display device of claim 1 wherein the majority of the polymer supports are bonded to each of the two substrates.

10. The liquid crystal display device of claim 1 wherein the polymer support
5 generally surrounds the exterior of the spacer element.

11. The liquid crystal display device of claim 1 wherein the polymer supports are primarily separate members not interconnected with one another.

10 12. The liquid crystal display device of claim 1 wherein one or more interconnecting regions of polymer interconnects a majority of the polymer supports.

13. The liquid crystal display device of claim 12 wherein one of the interconnecting regions comprises a layer of polymer adjacent one of the substrates.
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14. The liquid crystal display device of claim 1 wherein the PIE material is applied to the spacer elements before introduction of the spacer elements to the space between the substrates.

20 15. The liquid crystal display device of claim 1 wherein the PIE material is applied to the spacer elements after introduction of the spacer elements to the space between the substrates.

25 16. The liquid crystal display device of claim 1 wherein the PIE material is a coating applied to the spacer elements.

17. The liquid crystal display device of claim 1 wherein the spacer elements are dry sprayed on to the substrate before application of the electrooptic material.

30 18. The liquid crystal display device of claim 1 wherein the spacer elements are wet sprayed on to the substrate.

19. The liquid crystal display device of claim 18 wherein a solvent used for wet spraying comprises a PIE material or has a PIE material in solution or suspension.

5 20. The liquid crystal display device of claim 1 wherein the PIE material comprises one or both of the following: an initiator and an accelerant of the in situ polymerization process.

 21. The liquid crystal display device of claim 20 wherein the PIE material is light
10 activated.

 22. The liquid crystal display device of claim 21 wherein the PIE material comprises a photoinitiator.

15 23. The liquid crystal display device of claim 22 wherein the photoinitiator comprises a plurality of photoinitiators of different spectral sensitivities, so that polymerization may be initiated at different times in different locations.

 24. The liquid crystal display device of claim 21 or 22 wherein the light is ultraviolet
20 light.

 25. The liquid crystal display device of claim 20 wherein the PIE material is heat activated.

25 26. The liquid crystal display device of claim 20 wherein the PIE material is self-activated after a period of time following assembly of the display.

 27. The liquid crystal display device of claim 20 wherein the PIE material comprises both a photoinitiator and an accelerant.

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28. The liquid crystal display device of claim 1 wherein the electrooptic material and a prepolymer are applied between the substrates as a mixture, and during in situ polymerization a phase separation of the electrooptic material and the polymer occurs.

5 29. The liquid crystal display device of claim 1 or 28 wherein the electrooptic material is a liquid crystal material.

30. The liquid crystal device of claim 1 or 28 wherein the electrooptic material is a mesomorphic material.

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31. The liquid crystal display of claim 1 further comprising at least one electrode on at least one substrate to generate the electric field.

32. The liquid crystal display device of claim 32 further comprising at least one
15 electrode on the second substrate.

33. The liquid crystal display device of claim 1 wherein the polymer used for in situ polymerization of the substrates comprises an acrylic based adhesive.

20 34. The liquid crystal display device of claim 1 wherein the polymer used for in situ polymerization of the substrates comprises an epoxy-based adhesive.

35. The liquid crystal display device of claim 1 wherein the polymer used for in situ polymerization of the substrates comprises a urethane-based adhesive.

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36. The liquid crystal display device of claim 1 wherein the polymer used is primarily cured by light.

37. The liquid crystal display device of claim 1 wherein the polymer used is
30 primarily cured by heat.

38. The liquid crystal display device of claim 1 wherein the polymer used is primarily cured via intermixing of a chemical additive.

39. The liquid crystal device of claim 1 wherein the substrates comprise a flexible
5 polymer material.